Faunal Survey of the Green Spring Unit Colonial National Historical Park

PROJECT FINAL REPORT

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ABSTRACT

A fifteen month investigation was undertaken to inventory the faunal diversity of the Green Spring Unit of Colonial National Historical Park, a unit of the National Park Service. An ultimate goal was directed at evaluating the significance of this property to local biodiversity within a larger, and more rapidly changing surrounding landscape. Variable survey techniques were used to most accurately document the wildlife species that inhabit the property throughout the year. Species detected were mapped relative to habitat locations and repeated surveys made it possible to generate density estimates for most species. A total of 140 vertebrate species were documented for the property. They included 98 birds, 17 mammals, 13 reptiles, and 12 amphibians. Although no state or federally threatened or endangered species were documented on the property, there were several unique habitats that were identified and should be recognized in any land planning actions.

Two habitats were especially significant for both breeding and wintering species of multiple taxa because of their increasing rarity in the surrounding landscape:

- A small, seasonal scrub-shrub wetland harbored a unique vegetation community for the area; provided the only significant breeding site for amphibians on the property; and hosted the only community of a relatively uncommon mammal on the site.

- The transitional field to the east of Rt. 614 has regional significance because of its rarity. Native grassland and shrub habitats support not only a unique breeding community of birds, but receive visitation from numerous other species that live in adjacent habitats. This cover type is rapidly becoming the new “old growth forest” among conservationists.

Of additional importance, the hardwood dominated forest of the western property extension and along the western property boundary accounted for the majority of the larger mammal territories, the majority of the high canopy nesting birds, the highest density of winter bird visitors, and the most diverse community of reptiles and amphibians outside the breeding season. In every forested landscape in the eastern United States, a mature hardwood forest is the cornerstone of a diverse and stable faunal wildlife community, and this is one is a good example.

INTRODUCTION

This report completes a comprehensive inventory of the wildlife diversity of the Green Spring Unit of Colonial National Historical Park (COLO) in James City County, Virginia. As a prominent land management agency, the National Park Service is in the enviable position of being able to accommodate multiple public service missions. In this case, the primary charge is one of historic preservation. Yet, in meeting that mandate, there is often ample latitude to accommodate the additional needs of maintaining wildlife diversity.

The Green Spring Unit is one such example. It is uniquely situated as a separate parcel from the main Park. As such, it is increasingly becoming an island habitat surrounded by development and associated land conversion. Although the adjacent landscape has undergone dramatic changes during the period of NPS ownership, the pace of change is accelerating, and it would have been difficult to decipher what role the Green Spring Unit played in wildlife diversity if such a survey went undone. **The principal goal of this project was to provide a baseline measure of faunal diversity and assessing how best to maintain this diversity in the face of changing land management goals.**

Figure 1. **Location of Colonial National Historical Park along James and York Rivers in southeastern Virginia.**
Illustration courtesy of COLO.

The Green Spring Unit is approximately 78 hectares (195 acres) in size and largely rectangular in shape. It is located in southern James City County, Virginia, in the southeastern portion of the state. The property is approximately two kilometers north of the James River and four kilometers from the next nearest COLO property at Jamestown Island. It is bounded to the south by State Route 5, and is bisected along its longest axis by County Route 614 (Centreville Road). The property is currently bordered on two sides by residential development with another border slated for various development scenarios within the next five years. Approximately 72% of the area is forested. Eighteen percent is open field, and predominantly herbaceous in cover. Another 8% is open meadow, harboring archaeological sites and historic landscape features and is maintained in mixed, predominantly non-native grasses. A final 2% is in road and pipeline maintained right-of-way. Prior to this investigation, a floral survey was undertaken of the Green Spring Unit (Ingram, 1998) that served to categorize most of the habitats into general habitat units. For ease of interpretation, this report will attempt to adopt those same habitat descriptors where applicable.

The forest cover is largely mixed throughout in both species composition and age class. Specific components include a mature, pine upland forest area along the northern boundary; a mature, hardwood dominated component in the western most sections of the Unit, and two successional pine stands embedded in the north central area of the Unit adjacent to the western most fallow field.

The lower third of the Unit, separated from the upper portion by a gas line right-of-way, is comprised primarily of lowland mixed forest ((PFO1,4E- palustrine forested, (1) broad-leaved deciduous, (4) needle-leaved evergreen (E)seasonally flooded/saturated)). At least two components of this forest are predominantly hardwood, with mixed age classes (units 11 & 12). They differ from each other primarily in the quantity of understory vegetation.

Other unique habitat features include a complex wetland located in the north-central area of the Park. It varies from scrub-shrub (PSS01- palustrine scrub/shrub, broad leaved deciduous) to emergent (PEM – palustrine emergent) to forested (PFO4 – palustrine forested, needle leaved evergreen) within the confines of approximately one hectare. This wetland is seasonal in nature, but can harbor standing water for months at a time, enabling a substantial community of buttonbush (*Cephalanthus occidentalis*) and soft rush (Juncus effusus) to proliferate.

Further west, in the western boundary extension to the Park Unit, a system of small streams traverses the terrain in the only area of the Park to exhibit any significant topography. Here, hardwood ridges dominate this component with up to 9 meter changes in elevation over 50 meters traveled in linear distance (Ingram, 1998). Unfortunately, there is little herbaceous vegetation present due to overbrowsing by deer, and the streams are relatively devoid of aquatic life.

Regarding the field habitats, there is a stark difference between the fallow fields to the east, and the mowed fields west of Rt. 614, dominated by fescue. Fescue is an invasive, exotic species that with routine maintenance is effective at keeping other species from coming in. As a result, the historic sites and remaining structures stand out well and are more easily maintained. Conversely, the fallow field areas occasionally reach an almost impenetrable state, dominated by blackberry, wild cherry, sweetgum, and red maple saplings. As a result, this report will recognize these distinctly different open habitats as either fescue fields or wild fields.

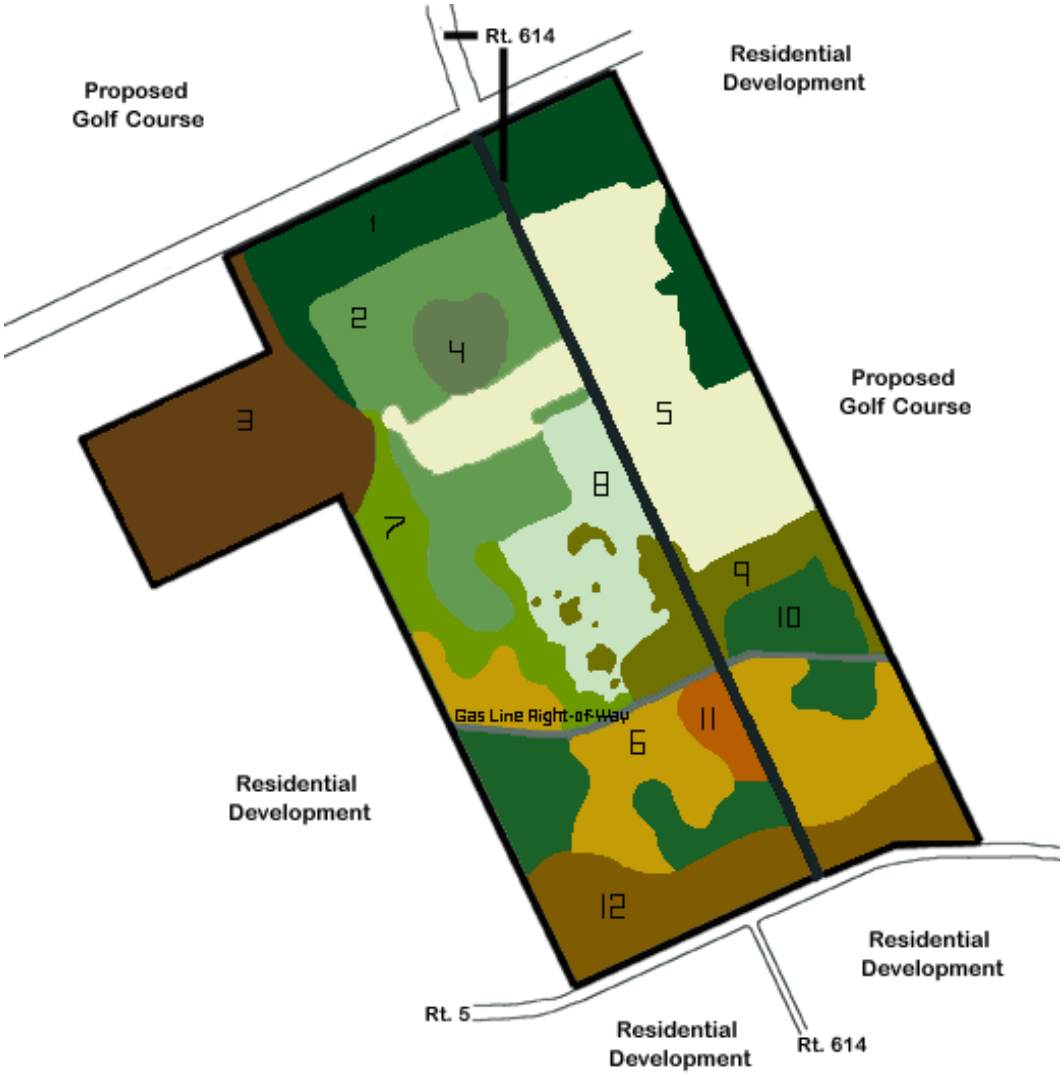

Figure 2. Overview of Green Spring's major habitat units and its context within the surrounding landscape.

Table 1. Green Spring Habitat Units

Habitat	**Description**
1	Mature, upland pine forest, with advancing hardwood midstory.
2	Successional pine forest: young, dense stands, with little light penetration.
3	Mature, mixed hardwood/pine. Hardwood ridges, midstory sporadic, but dense at times.
4	Combination scrub-shrub/emergent/palustrine forested pine wetland. Small, but valuable.
5	Transitional field; rich herbaceous cover, with mixed woody saplings.
6	Mixed pine/hardwood. Mostly mature pine, w/hardwood co-dominants and midstory.
7	Mixed upland hardwood. Relatively open, little ground cover.
8	Mowed non-native, sod-forming grasses; occlude open ground.
9	Brush, mixed hardwood; copious vines, treefalls, logs, etc.
10	Lowland, semi-mature pine-dominated, mixed stand.
11	Lowland, mixed hardwood; rich herbaceous cover, low tree basal area.
12	Lowland, mixed hardwood; less herbaceous cover, higher basal area, older.

SURVEY METHODOLOGY

Survey work involved several methodologies depending on the taxa involved. All investigation methods were designed to be benign techniques, with no intent to mark, collect, or hold for study. For the bird work, a variation of the standard point-count methodology was used. As a result of the configuration of the habitats involved, the fixed point survey design was abandoned in favor of a walking survey, to better associate birds with the specific habitat involved. This effort involved moving slowly throughout the Park Unit and stopping periodically to record all birds that could be seen or heard and mapping them to their respective habitats. This type of survey is typically preferred in the winter when there are fewer auditory cues to aid in detection, but it worked equally well here in the breeding season since density estimates were less important than diversity. A walking survey provided more complete coverage of all the habitats and therefore greater probability of exposure to all the bird species present. Bird surveys were conducted two to three times a month throughout the winter and at least weekly during the spring migration period and during the breeding season. Occasionally, spot surveys were conducted in unique habitat types or during peak migration periods to increase detection probabilities of rare or more transient species.

Mammal surveys varied depending on the size class. The larger mammals were typically detected visually on one or more of the bird surveys over the course of the survey period. Small mammals were investigated using Sherman live traps baited with an assortment of small grains and nuts. Traps were placed in a grid pattern using from 20 to 40 traps per grid. They were set in the afternoon and checked the following morning just after sunrise. The traps were left in place for a minimum of 5 days at a time or until a capture was made. All captured specimens were transferred to a holding cage where they could be easily observed or handled, if necessary, to confirm identification. Specimens were released upon identification at the point of capture. Small mammal trapping took place primarily in the late summer through fall of 1998, with some pilot efforts in the spring. An additional survey effort that was used involved scanning the roads adjacent to Green Spring for species hit by vehicle, or “road kills”.

Reptile and amphibian surveys were conducted year round according to species’ activity patterns. Frogs and salamander investigations were begun in the late winter when the first species emerge to

breed or to hatch into their larval form. In the case of frogs, all areas supporting standing water were evaluated weekly or during a rain event from mid-February through August to detect vocalizing males in search of mates. Species were identified and numbers estimated by vocalizations. Within these same wetlands, more intensive work was done by flashlight and net searching at night to evaluate the presence of larval salamanders or breeding adults. The salamander work was concentrated more within the spring and fall periods during these species' periods of peak activity.

Since salamanders tend to be more nocturnal in their activity patterns, the principal investigation method was intended to be an array of pitfall traps. Initially a pilot effort was established using a standard setup with 4 pitfalls arranged in a "Y" pattern with each arm of the "Y" comprised of 10 to 16 inch aluminum flashing mounted on edge in a 10 meter linear array connected to two pitfalls. The final design showed three perimeter pitfalls equidistant apart each connected by a 10 meter runway to a central hub pitfall. This setup was erected in the mixed pine forest near the principal wetland site. Unfortunately, the trade-off in using this technique is the risk of shrew mortality. Since these species have such high metabolic rates, mortality rates are high for most shrews confined in such a situation, sometimes even for just a few minutes. After our pilot effort, and after consideration of the size of the Green Spring Unit and its available breeding sites for amphibians, we decided to abandon the pitfall array. It was clear that the shrew mortality would probably be excessive relative to the gains in amphibian detection. To compensate, more time was spent searching potential amphibian hiding places under logs or debris and around moist areas on the forest floor. In addition, nocturnal roving surveys were conducted during rain events to detect salamanders on the move.

Reptile surveys were basically conducted in conjunction with most other survey efforts. Wetland surveys for frogs and amphibians were effective at turning up turtles, just as roving bird surveys were effective at exposing the surveyor to snakes, lizards and box turtles. Unfortunately, a number of reptile species were recorded from the surface of Route 614.

As with reptiles, other taxonomic groups that were investigated in the course of the primary survey efforts were the butterflies and dragonflies. This effort stemmed mainly from an interest in migratory species and the role the Green Spring Unit might play in providing safe harbor to numbers of such species. As such, specimens were recorded as encountered and identified to the extent possible without collecting. Many species were netted and released, but none collected for preservation.

BIRDS

There were 98 species of birds documented for the Green Spring Unit during the survey period. To appreciate this diversity and to more fully identify the importance of the Park Unit to birds, it will be important to first understand the different life cycle strategies that different groups of birds exhibit. For the purposes of this report, birds have been categorized into 1 of 4 different categories based on their annual movement patterns: 1) residents, 2) temperate migrants, 3) neotropical migrant breeders, 4) and neotropical migrant transients.

Resident birds include the familiar birds that spend their entire lives in a relatively small geographic area, often on the same territory. Examples include cardinals, chickadees, and most woodpeckers. One might find these birds at any time of the year on, or in association with, the Park Unit. This study documented 29 resident species of birds.

Bald Eagle	Downy Woodpecker	Carolina Wren	Brown-headed Cowbird
Red-shouldered Hawk	Hairy Woodpecker	Northern Mockingbird	Common Grackle
Red-tailed Hawk	Pileated Woodpecker	Brown Thrasher	House Sparrow
Northern Bobwhite	American Crow	European Starling	American Goldfinch
Wild Turkey	Fish Crow	Pine Warbler	House Finch
Great-horned Owl	Tufted Titmouse	Northern Cardinal	
Eastern Screech Owl	Carolina Chickadee	Field Sparrow	
Red-bellied Woodpecker	White-breasted Nuthatch	Eastern Meadowlark	

Temperate migrants typically comprise those species that breed primarily in the arctic and northern temperate latitudes and withdraw to the mid- and southern temperate latitudes during the winter. Their wintering population is typically confined to the central and southern United States. In effect, they make up our avian winter visitors. Somewhat confusing among this group of birds are a few temperate latitude species that we take for granted as being resident all year round, when if fact, the birds that are present here in the breeding season are actually replaced by individuals that come down from the north during the fall. So even though the species is represented year round, the individual birds differ with the seasons. Twenty-six species were documented that conform to the movement patterns of temperate migrants. Of that total, 11 species exhibit the strategy described above, with mid-latitude breeding individuals being replaced by northern migrants in the fall, creating an illusion of year-round residents. Those species are italicized in the list below.

Wood Duck	Ruby-crowned Kinglet	*Chipping Sparrow*
Sharp-shinned Hawk	*Eastern Bluebird*	Dark-eyed Junco
Cooper's Hawk	Hermit Thrush	White-throated Sparrow
American Kestrel	*American Robin*	White-crowned Sparrow
Mourning Dove	Cedar Waxwing	Swamp Sparrow
Northern Flicker	Yellow-rumped Warbler	*Red-winged Blackbird*
Blue Jay	Rufous-sided Towhee	Rusty Blackbird
Brown Creeper	*Song Sparrow*	
Winter Wren	American Tree Sparrow	
Golden-crowned Kinglet		

The term neotropical migrant refers to those species that winter in the tropics and return to the temperate and northern latitudes to breed. The distinction as neotropical migrant *breeders* is meant only to distinguish those neotropical migrants that breed within the boundaries of the Green Spring Unit or immediate surrounding area. This study confirmed 35 such species occurring at Green Spring during the breeding season that are known to winter primarily south of the continental United States.

Green-backed Heron	Barn Swallow	Kentucky Warbler
Yellow-billed Cuckoo	House Wren	Hooded Warbler
Chimney Swift	Blue-gray Gnatcatcher	Ovenbird
Ruby-throated Hummingbird	Wood Thrush	Louisiana Waterthrush
	Gray Catbird	Common Yellowthroat
Eastern Kingbird	White-eyed Vireo	Yellow-breasted Chat
Great-crested Flycatcher	Yellow-throated Vireo	American Redstart
Eastern Wood-Pewee	Red-eyed Vireo	Blue Grosbeak
Acadian Flycatcher	Northern Parula	Indigo Bunting
Tree Swallow	Black-and-white Warbler	Orchard Oriole
Purple Martin	Yellow-throated Warbler	Scarlet Tanager
Northern Rough-winged Swallow	Prairie Warbler	Summer Tanager

Likewise, neotropical migrant *transients* refers to those species that overwinter in the tropics and travel through the temperate latitudes on their way back to breeding territories in the northern latitudes or higher temperate altitudes. They are usually seen only for brief periods during migration in the spring, and to a lesser extent, in the fall. Eight such species were documented during migration at the Green Spring Unit.

Swainson's Thrush	Black-throated Green Warbler	Northern Waterthrush
Blue-winged Warbler	Blackpoll Warbler	Rose-breasted Grosbeak
Magnolia Warbler	Palm Warbler	

Of the 98 total species documented during the survey period, 60 were represented by at least a singing or territorial male suggesting those species were breeding within the Park Unit. These include 26 species from the resident bird list, 7 of the temperate migrants, and 27 of the neotropical migrants. A (b) by the species name in Table 2 indicates a breeding species in the Green Spring Unit. Not all species from the resident bird list are indicated as breeders at Green Spring. Reasons for this include lack of confirmation of either a pair, a territorial male, eggs, or young. In the case of birds of prey, territories may be so large that Green Spring is simply a foraging area, with nesting taking place in another woodlot nearby. Likewise, not all species listed on the neotropical migrant breeders list actually nested at Green Spring. Examples include the Chimney Swifts and swallows, which may have used Green Spring as a primary foraging area, but nested off site in more specialized habitats. In addition, some of the neotropical migrants that breed locally were seen at Green Spring during migration, but not during the breeding season. This was probably an artifact of either insufficient or unsuitable habitat for breeding.

Several of the birds warrant additional discussion. Green-backed Herons were seen regularly at the wetland site (Habitat Unit (HU) #4), as many as 4 individuals at a time. Later, a nest was discovered in a young pine stand immediately immediately adjacent to Green Spring's southwest corner. This nest produced at least two young, but it was not determined whether the young fledged successfully. The wetland dried up by late June and would not have harbored accessible prey after that point. It is interesting though that the herons responded to this area as a productive breeding site. That suggests that the wetland, although temporary, was rich in animal prey.

It was also encouraging to detect two other species that appeared to be breeding in the Unit: Black-and-white Warblers, and Hairy Woodpeckers. Although resident, Hairy Woodpeckers are a more reclusive species and typically found in association with larger, more mature, blocks of forest. However both male and female Hairy Woodpeckers were observed in the western property extension of the Unit (HU#3). Likewise, at least three Black-and-white Warblers were detected singing throughout the breeding season in

three different sections of the forest along Rt. 614. A neotropical migrant, this warbler is thought to be area-sensitive, requiring large acreages of habitat in which to breed. It is somewhat uncommon as a breeding species in eastern Virginia, and so was surprising to find throughout the breeding season at Green Spring.

Other surprise neotropical migrants included Kentucky Warblers which favor large blocks of lowland hardwood forest. Two singing males were detected throughout the breeding season in the deciduous forested wetland area near the junction of Routes 5 and 614 (HU#11). Likewise, Yellow-breasted Chats, a declining species, and Prairie Warblers were both detected during the breeding season in association with the shrub components of the scrub-shrub wetland, as well as the linear array of juniper trees that border the fescue field. These species are true shrub habitat specialists and were not expected in such a fragmented habitat.

During both spring and fall migration, the open habitats also received intense visitation from migratory swallows and Chimney Swifts. Purple Martins, in particular, were present in large numbers during fall migration, as were Chimney Swifts. One temperate migrant that occurred in very large numbers in the field habitats was Eastern Bluebird. Over 40 individuals were observed on one day in September foraging from the trees spaced across the fescue fields to the west of Rt. 614 (HU#8). These birds staged here for several days before eventually moving off en masse. Of additional interest, there was one House Sparrow detected over the course of the survey period, and that bird was captured in a Sherman small mammal trap. No other individuals were detected before or after that event, although it is probably just a matter of time before they become a permanent feature of the landscape.

Finally, Green Spring serves the distinction of having to be a “good neighbor” to an adjacent residential housing complex because of a notable resident. A pair of Bald Eagles constructed a nest within 50 meters of the Unit in 1997 and have produced young successfully at the site. The nest has been confirmed active again this year with adults known to be incubating eggs. This species is still listed as Federally endangered and warrants the accompanying habitat protection buffers accorded such species. Follow-up surveys this spring will confirm productivity results of this pair and any pertinent information will be forwarded to COLO.

MAMMALS

Mammal diversity was representative of similar habitats throughout the Coastal Plain, although many species appeared to be present in lower densities than expected. No rare or threatened species were encountered. In particular, the small mammal community was quite diverse, although even the very common species exhibited a very low capture ratio during the trapping phase. The least common species relative to trapping success were the Eastern Harvest Mouse and Least Shrew. Two harvest mice were trapped and released within the dense clumps of grasses and rushes associated with the scrub-shrub wetland area (HU#4), during drought conditions. Although harvest mice are common throughout Virginia and the Carolinas, they tend to be very localized in distribution, and there are few records for James City County. Likewise, only two Least Shrews were detected; one visually and one by trapping. Both were found in the deciduous wetland areas near the confluence of Rt. 614 and Rt. 5 (HU#12). Only one Hispid Cotton Rat was detected as well as one Eastern Mole, and both of them were discovered as road-kills. The cotton rat may have been too large for the Sherman live traps that were used, so there should be no correlation drawn between trap success and distribution or abundance. This species is likely to be a common resident of the wild fields when ample cover is available. Likewise, the Eastern Mole was not likely to be trapped due to its subterranean travels, so the one specimen should not be used as an indicator

of abundance. One Striped Skunk was also killed crossing Rt. 614 this fall. This may have been a transient animal. No other evidence of skunks was observed over the course of the survey period.

The most widely distributed species relative to trap data appeared to be White-footed Mice followed by Northern Short-tailed Shrews. These two species were trapped in almost every habitat including the fescue fields. In spite of their broad distribution however, neither of these species appeared to be densely distributed. The maximum trapping success ratio for any habitat was 8 mice per 100 trap nights in forest edge habitats. This may have been an artifact of the drought conditions however, since most of the small mammal trapping took place in the summer and fall of 1998.

In contrast, one surprisingly absent species was the Eastern Chipmunk. Although the Coastal Plain populations of this species are localized and disjunct, we anticipated detection of chipmunks on the site. In view of their presence on nearby COLO properties, and around Williamsburg, it should be assumed that this species has access to the site if not a permanent resident.

Among the larger mammals, densities of most also appear to be relatively low, probably because of the patch sizes of the available habitat types. Red foxes, although seen on the property, may be primarily a visitor species now. At least three fox dens were located but all had been abandoned and showed no signs of recent use. One of the dens had been taken over by woodchucks. Although raccoons were observed on two occasions, there is little in the way of wetlands to sustain a prey base for raccoons, so these individuals may be acclimating to the increasing human encroachment and the inevitable scraps and refuse that accompany it. Likewise, this same increase in human activity may be responsible for the apparent reduction in fox activity.

REPTILES AND AMPHIBIANS

Year round surveys documented thirteen reptile species: 7 snakes, 3 turtles, and 3 lizard species, listed below;

Snakes	Turtles	Lizards
Black Rat Snake	Eastern Box Turtle	Broadhead Skink
Northern Black Racer	Eastern Mud Turtle	Five-lined Skink
Eastern Garter Snake	Eastern Musk Turtle	Ground Skink
Eastern Ribbon Snake		
Rough Green Snake		
Southern Ring-neck Snake		
Eastern Worm Snake		

and twelve amphibian species: 6 frogs, 2 toads, and 4 salamanders, as listed:

Frogs	Toads	Salamanders
Green Frog	American Toad	Spotted Salamander
Leopard Frog	Fowler's Toad	Marbled Salamander
Pickerel Frog		Three-lined Salamander
Spring Peeper		Four-toed Salamander
Upland Chorus Frog		
Gray Treefrog		

None of the reptile species were unexpected. All are common in appropriate habitats throughout the mid-Atlantic region. There are several other reptile species that are probably resident at Green Spring, but were not detected during this survey effort. They primarily include snake species such as Eastern Hognose Snake, Smooth Earth snake, and Rainbow snake. The latter two species spend most of their time burrowed in the soil making detection more difficult.

Among the amphibians, the frog diversity was greater than expected for the size and isolation of the wetlands available. The species detected represent the majority of common species present in eastern Virginia. There were no rare species observed. The two toads are the common species for this part of the state. A less common species, the Spadefoot toad, historically occurred about a mile away, but disappeared with development pressures. The habitat is suitable to harbor that species at Green Spring but it was not detected.
At least one amphibian species in larval form was detected, but could not be readily identified. An error was made by the survey team in not preserving a specimen for future referral, and an early identification could not be substantiated later. The species in question was a possible Mabee's Salamander. Habitat conditions and seasonality were appropriate for the species, but it closely overlaps another local species, the Marbled Salamander, and juveniles of the two species are virtually indistinguishable in the field. The Mabee's Salamander is a state threatened species and an intensive follow-up effort is under way this spring to resolve the issue. At present however, the species is being omitted from any formal reference until a*dditional specimens can be examined, and an effort is continuing to locate new specimens.

INSECTS

A less intensive survey effort was targeted at certain groups of insects. The principal interest in insects was in the diversity and abundance of migratory species, or species that might depend on some aspect of Green Spring as a staging or refueling area prior to moving on. As such, all species of butterfly, dragonfly, and to a lesser extent, damselfly, were noted and identified to the extent possible, and any remarkable events were recorded.

Twenty butterfly species were confirmed and several additional unknowns were detected. The earliest species detected was a Question Mark on February 19, 1998. The last two butterflies observed were a Buckeye and a Cloudless Sulphur on November 10, 1998. The most abundant species appeared to be an extremely large group of Eastern tailed-blues, observed in early June at the cabled NPS entrance. There were over 120 individuals observed within a 50 square foot area. The most common species observed throughout the summer months was the Tiger Swallowtail. This species was observed in large numbers throughout the late spring and early summer foraging on buttonbush when it was in bloom.

Eight species of dragonfly were observed and identified, as well as 6 damselfly species. At least two additional species of each were inaccessible and went unidentified. Although unsubstantiated, one

dragonfly species was observed that appeared to be a species unrecorded in Virginia: the Roseate Skimmer (Dunkle, 1989). With its diagnostic coloration this species would appear unmistakable. The common coloration of the adult male shows a pale blue thorax with a pinkish to reddish abdomen. It inhabits weedy fields where it perches on weed stems and ambushes passing prey. The species is quick and an agile flyer. This describes the specimen exactly that was observed in the wild field to the right of Rt. 614 (HU#5) in late July. The dragonfly in question had a solid pink abdomen that abruptly ended at a pale dusty blue thorax. It was observed at a distance of approximately 10 feet with 7x binoculars and studied for several minutes. No equipment was immediately available to assist in capturing it. This description was recently given to the resident insect expert at the state Natural Heritage office who confirmed that the species was unrecorded in Virginia. Unfortunately, without a specimen, there is no way to substantiate it for a state record.

One additional insect event was recorded because of its local significance. The emergence of huge numbers of periodical cicadas took place in late May and seemed to be centered approximately in the Green Spring Unit area. The density of these insects was so great that their collective vocalizations literally drowned out all bird vocalizations overhead. It was difficult to walk into the forest without stepping on numbers of insects or their vacant pupa casings. Away from Green Spring, numbers of the insect dropped off dramatically, and the species was barely observed elsewhere in the James City County area.

HABITAT EVALUATION

In order to better assess the overall significance of various habitats, Table 1, recreated below illustrates the twelve habitat types of Green Spring representing different vegetational components. Differences may appear subtle, but minor changes often yield dramatic differences in wildlife species composition. These habitat types are used to relate species to different components of the Green Spring Unit by way of the following species tables. Within each table, the species detected in this study are listed, along with an estimate of abundance, based on the surveys conducted. In the case of several mammals, a few birds, and many of the reptiles and amphibians, there were insufficient detections to estimate densities, or abundance. In those cases, an estimate is used based on known studies from similar habitats in the region, and will be denoted with an asterisk. Where species were so rarely detected as to total only one or two individuals, the specific numbers will be listed. In the case of birds, specific numbers imply singing males, and therefore should be assumed to represent a pair. Also listed are the typical habitats preferred by the species, and the habitat type in which the species was detected at Green Spring.

Table 1. Habitat Descriptions

Habitat	**Description**
1	Mature, upland pine forest, with advancing hardwood midstory.
2	Successional pine forest: young, dense stands, with little light penetration.
3	Mature, mixed hardwood/pine. Hardwood ridges, midstory sporadic, but dense at times.
4	Combination scrub-shrub/emergent/palustrine forested pine wetland. Small, but valuable.
5	Transitional field; rich herbaceous cover, with mixed woody saplings.
6	Mixed pine/hardwood. Mostly mature pine, w/hardwood co-dominants and midstory.
7	Mixed upland hardwood. Relatively open, little ground cover.
8	Mowed non-native, sod-forming grasses; occlude open ground.
9	Brush, mixed hardwood; copious vines, treefalls, logs, etc.
10	Lowland, semi-mature pine-dominated, mixed stand.
11	Lowland, mixed hardwood; rich herbaceous cover, low tree basal area.
12	Lowland, mixed hardwood; less herbaceous cover, higher basal area, older.

Table 2. Bird Status, Abundance, and Habitat Use

Common Name	Species	S[1]	Ab[2]	Habitat(s)[3]	Found
Green-backed Heron	Butorides striatus	p	IC	Forested wetland	4
Wood Duck	*Aix sponsa*	b	UC	Mature hdwds, wetl.	3
Bald Eagle	Haliaetus leucocephalus	/	R	Mature forest edges	0
Sharp-shinned Hawk	*Accipiter striatus*	v	UC	Field/forest edges	5,8
Cooper's Hawk	Accipiter striatus	/	IC	Field/forest edges	,8
Red-shouldered Hawk	*Buteo lineatus*	v	UC	Mature hdwd forest	3
Red-tailed Hawk	Buteo jamaicensis	p	P	Fields & edges	,8,9
American Kestrel	*Falco sparverius*	v	UC	Fields	5,8
Northern Bobwhite	Colinus virginianus	p	IC	Fields, forest edges	,9
Wild Turkey	*Meleagris gallopavo*	b	UC	Mature forest, fields	1,3,5,8
Mourning Dove	Zenaida macroura	p	P	All	All
Yellow-billed Cuckoo	*Coccyzus americanus*	b	C	Hdwd & mixed forest	3,6,7,9
Great Horned Owl	Bubo virginianus	p	P	Mature forest, fields	,3,5,
Eastern Screech Owl	*Otus asio*	b	C	Mature forest, edges	1,3,7
Chimney Swift	Chaetura pelagica	/	P	Open areas	,5
Ruby-thr. Hummingbird	*Archilocus colubris*	b	C	Hdwd forest, edges	9,11,12
Red-bellied Woodpecker	Melanerpes carolinus	p	`	All forested	lot 2
Northern Flicker	*Colaptes auratus*	b	C	Mature pines	1,3,6
Downy Woodpecker	Picoides pubescens	p	`	All forested	All for.
Hairy Woodpecker	*Picoides villosus*	b	(2)	Mature forest	3
Pileated Woodpecker	Dryocopus pileatus	p	P	Mature forest, hdwd.	,3,7,9
Eastern Kingbird	*Tyrannus tyrannus*	b	(1)	Forest edges, fields	7,8,9
Great Crested Flycatcher	Myiarchus crinitus	p	P	Mixed forest, edges	,6,7,9+
Eastern Wood-Pewee	*Contopus virens*	b	C	Mixed forest, edges	1,3,6,7+
Acadian Flycatcher	Empidonax virescens	p	P	Moist forest	,9,11,+
Tree Swallow	*Tachycineta bicolor*	v	UC	Open areas	5,8
Purple Martin	Progne subis	/	P	Open areas	,8
N. Rough-winged Swallow	*Stelgidopterixserripennis*	v	UC	Open areas	5,8
Barn Swallow	Hirundo rustica	/	P	Open areas	,8
Blue Jay	*Cyanocitta cristata*	b	C	Mature forest, edges	3,7,9
American Crow	Corvus brachyrhynchos	p	P	All	All

Fish Crow	*Corvus ossifragus*	v	UC	All	8
ufted Titmouse	*arus bicolor*	ɔ	ˌ	ll forested, edges	ˌll for.
Carolina Chickadee	*Parus carolinensis*	b	A	All forested, edges	All for.
rown creeper	*erthia americanus*	/	3)	ixed forest	,6,7
White-breasted Nuthatch	*Sitta carolinensis*	b	C	All mature forest	1,3,6,7+
ouse Wren	*roglodytes aedon*	ɔ	1)	orest edges	
Winter Wren	*Troglodytes troglodytes*	v	(2)	Brushy forest, edges	9,12
arolina Wren	*hryothorus ludovicianus*	ɔ	ː	ixed forest, edges	,3,6,7..
Golden-crowned Kinglet	*Regulus satrapa*	v	UC	Mixed forest, edges	3,6,7,9+
uby-crowned Kinglet	*egulus calendula*	/	IC	ixed forest, edges	,6,7,9+
Blue-gray Gnatcatcher	*Polioptila caerulea*	b	A	Mixed forest, edges	3,6,7,9+
astern Bluebird	*ialia sialis*	ɔ	ː	orest edge, open	,8,9
Wood Thrush	*Hylocichla mustelina*	b	C	Mature forest	3,6,7,12
wainson's Thrush	*atharus ustulatus*	/	2)	ixed hdwd forest	,11
Hermit Thrush	*Catharus guttatus*	v	A	Mixed forest, edges	All for.
merican Robin	*urdus migratorius*	ɔ	ˌ	ixed forest, edges	,6,7,9+
Gray Catbird	*Dumetella carolinensis*	b	UC	Scrub, edge habitats	7,9
lorthern Mockingbird	*imus polyglottos*	ɔ	IC	pen areas, edges	
Brown thrasher	*Toxostoma rufum*	b	UC	Mixed forest, edges	6,7,9
edar Waxwing	*ombicilla cedrorum*	/	IC	dges, open areas	,9
European Starling	*Sturnus vulgaris*	b	C	Edges, open areas	8
hite-eyed Vireo	*ireo griseus*	ɔ	IC	crub, edge habitats	,9
Yellow-throated Vireo	*Vireo flavifrons*	b	(2)	Hdwd mixed/lowland	3,12
ed-eyed Vireo	*ireo olivaceus*	ɔ	ː	dwd & mixed forest	,3,6,7+
Blue-winged Warbler	*Vermivora pinus*	v	(1)	Shrub, edge habitats	9
lorthern Parula	*arula americana*	ɔ	2)	oist mature hdwd	2
Black-and-white Warbler	*Mniotilta varia*	b	UC	Mature forest	1,3,6,12
agnolia Warbler	*endroica magnolia*	/	ICT	ixed forest, edges	,6,7,9,
Yellow-rumped Warbler	*Dendroica coronata*	v	C	Mixed forest, edges	All, xc 2
lack-throated Green W.	*endroica virens*	/	2)	ixed forest, canopy	1,12
Yellow-throated Warbler	*Dendroica dominica*	b	(3)	Mature moist forest	3,6,12
rairie Warbler	*endroica discolor*	ɔ	IC	hrubby, field habitat	
Blackpoll Warbler	*Dendroica striata*	v	A	Mixed forest	Not 2
ine Warbler	*endroica pinus*	ɔ	ˌ	ature pine forest	,3,10
Palm Warbler	*Dendroica palmarum*	v	(2)	Scrub, field edges	7,9
entucky Warbler	*porornis formosus*	ɔ	2)	oist hdwd forest	1
Hooded Warbler	*Wilsonia citrina*	b	(2)	Scrubby,mixed forest	7,9
venbird	*eirus aurocapillus*	ɔ	IC	ixed, mature forest	,3,6,7+
Louisiana Waterthrush	*Seiurus motacilla*	v	(1)	Forested wetlands	3,11
lorthern Waterthrush	*eiurus noveboracensis*	/	1)	orested wetlands	1
Common Yellowthroat	*Geothlypis trichas*	b	C	Scrub, forest edges	5,7,9
ellow-breasted Chat	*cteria virens*	ɔ	1)	hrubby,fields,edges	,7
American Redstart	*Setophaga ruticilla*	v	UC	Scrubby hdwd,edges	6,7,9,11
ose-breasted Grosbeak	*heucticus ludovicianus*	/	2)	dwd forest, edges	, 9
Northern Cardinal	*Cardinalis cardinalis*	b	C	Mixed forest, edges	3,6,7,9..
lue Grosbeak	*uiraca caerulea*	ɔ	IC	ield	
Indigo Bunting	*Passerina cyanea*	b	C	Field, forest edges	5,7,8.9
astern Towhee	*ipilo erythrophthalmus*	ɔ	ː	orest edges, scrub	,6,7,9
Song Sparrow	*Melospiza melodia*	v	C	Brushy borders, field	5,8,9
merican Tree Sparrow	*pizella arborea*	/	IC	rushy borders, field	, 9
Field Sparrow	*Spizella pusilla*	b	C	Brushy borders,fields	5,6,9
hipping Sparrow	*pizella passerina*	ɔ	IC	orest edge, open	,8,9
Dark-eyed Junco	*Junco hyemalis*	v	C	Forest edges,borders	5, 7,8,9
hite-throated Sparrow	*onotrichia albicollis*	/	ː	orest edges, shrubs	,7,9
White-crowned Sparrow	*Zonotrichia leucophrys*	v	R	Brushy field edges	5
wamp Sparrow	*elospiza geoginana*	/	2)	oist scrub, edges	,9
Eastern Meadowlark	*Sternella magna*	b	UC	Fields, meadows	8
ed-winged Blackbird	*gelaius phoeniceus*	/	IC	crub, edges, fields	,8,9
Rusty Blackbird	*Euphagus carolinus*	v	UC	Lowland mixed forest	11,12
rown-headed Cowbird	*olothrus ater*	ɔ	ː	dges, fields	,7,8,9
Common Grackle	*Quiscalus quiscula*	b	C	Mixed forest, edges	6,7,9
rchard Oriole	*cterus spurius*	ɔ	IC	dges, open areas	,8,9
Scarlet Tanager	*Piranga olivacea*	b	UC	Mature hdwd forest	3,7,11,+

ummer Tanager	*iranga rubra*	ɔ	IC	Mixed forest	,3,6,9
House Sparrow	*Passer domesticus*	v	(1)	Open areas, edges	8
merican Goldfinch	*arduelis tristis*	ɔ	ˌ	Fields, mixed forest	,5,7,9
House Finch	*Carpodacus mexicanus*	b	UC	Forest edge, open	7,8,9

[1] = Status: b-breeder at GS, v-visitor
[2] = Abundance: A-abundant; C-common; UC-uncommon; UCT-uncommon transient; R-rare; (#) = actual number
[3] = Habitats where the species normally occurs. Hdwd=hardwood; for.=forest

Table 3. Habitats According to Highest Detected Bird Diversity

Hab.	**SD***	**Explanation**
9	61	Vines, treefalls, etc. create vertical structure; Mature hardwoods together with excellent dge habitats along transitional field and 614 affords highest overall species diversity.
7	50	Excellent edge habitat plus main movement corridor from one end of Unit to other.
3	42	Principle breeding habitat for canopy species; plus topography facilitates changes in abitat structure leading to greater bird diversity. Best mix of migrants and residents.
6	36	Good edge habitat along pipeline corridor and Rt. 614. Enhanced by wetland aspects.
8	30	Value rests largely on scattered trees within, and excellent edge habitats all around. Short grasses for raptors; lone trees for flycatchers, bluebirds, flocking species.
11	29	Excellent forested wetland site, good herbaceous cover, understory. Key breeders ncluded Kentucky Warblers, Scarlet Tanagers. Highest neotrop. migrant diversity.
12	28	Excellent hardwood habitat, but not enough understory, and too close to Rt. 5. Noisy.
5	27	Value lies totally in its existence as transitional site. All bird records are pre-mowing.
1	23	Excellent mature pine site, good hardwood midstory encroachment will continue to ncrease bird diversity.
10	18	Good medium aged pine-dominated mixed habitat. Loses out to adjacent hdwd stands.
4	6	Green-backed Heron and Swamp Sparrow best things about it for birds. Too small.
2	3	Dead zone. No sunlight, no vegetation, no birds. Too dense to move through easily.

*SD = species diversity (number species detected)

Figure 3. The following illustration displays the Green Spring Unit's habitat mosaic relative to overall bird diversity over the course of a year. Highest bird diversity is represented by the darkest color with color fading as bird diversity drops. Values derived from Table 3 above. Numbers correspond to habitat units in Table 1. *Base illustration, NPS.*

Table 4. Mammal Abundance and Habitat Associations

Common Name	Species	Abundance	Habitat(s) / Located**
Virginia Opossum	*Didelphis virginiana*	(3) C* locally	All / 8,9
Nor. Short-tailed Shrew	*Blarina brevicauda*	A	All / All but 2
Least Shrew	*Cryptotis parva*	UC	Weeds,fields / 11
Eastern Mole	*Scalopus aquaticus*	(1 rdkill) A*	Fields, edges / 5, 8
Eastern Cottontail	*Sylvilagus floridanus*	UC	Edges, fields / 5, 7, 8, 9
Woodchuck	*Marmota monax*	(4)	Edges, fields / 3, 5, 8, 9
Gray Squirrel	*Sciurus carolinensis*	C	Hardwoods / 1,3,6,7,9,12
Southern Flying Squirrel	*Glaucomys volans*	(2) C* locally	Mature forest,edges 3,7
Eastern Harvest Mouse	*Reithrodontomys humulis*	UC	Dense, weedy habitats / 4
White-footed Mouse	*Peromyscus leucopus*	A	Upland edges / 3,5,6,7,8,9
Hispid Cotton Rat	*Sigmodon hispidus*	(1 rdkill) UC*	Fields / 5
Meadow Vole	*Microtus pennsylvanicus*	UC	Fields,marshes /4,5
Woodland (Pine) Vole	*Microus pinetorum*	UC	Forest, fields / 1,2,3,4,6,7
Red Fox	*Vulpes vulpus*	(2) UC*	Borders,woodlots/ 3,7,9
Raccoon	*Procyon lotor*	(3) 1 rdkill	Lowland forest / 3,6,12
Striped Skunk	*Mephitis mephitis*	(1 rdkill) UC*	All upland hab / 7
White-tailed Deer	*Odocoileus virginianus*	C	All / 3,5,7,8,9.

** Habitats = typical habitat type species known to occur in.
Located = habitats where species was actually encountered at Green Spring

Table 5. Habitats with Highest Detected Mammal Diversity.

Habitat	SD*	Explanation
3	8	Best mature hardwood stand, mast production, water sources, trees with cavities.
5	8	Pre-mowing conditions afforded good cover, and good food sources.
9	8	Good edge habitats, lots of treefalls,logs for shelter, mast, heavy leaf litter.
7	7	Good protected movement corridor with ample food.
6	6	Edge habitats abound, herbaceous cover for food, shelter, links to pipeline corridor.
8	6	Open grazing area, and forage area for insects. Native grasses would improve area.
1	3	Food and cover poor. Some cavities, but generally too close to disturbances.
4	3	Uniquely vegetated making it suitable to odd assemblage of small mammals.
12	3	Wetlands and mast trees, but too close to road. Primarily used for travel corridor.
11	2	Too small for avg. territory, too wet for most small mammals.
2	1	One pine vole captured here. Probably just passing through.
10	1	Too much pine for tree dwellers, too wet for most ground dwellers.

SD* - Species detected. Not a good measure of species diversity in this case, since no trapping efforts were undertaken for larger mammals.

Figure 5. **The following illustration depicts the mosaic of habitat units relative to mammal detections over the course of the study. The darkest color represents highest number of species detected with fading colors indicating a proportional drop in species observed. Numbers represent habitat units from Table 1.**

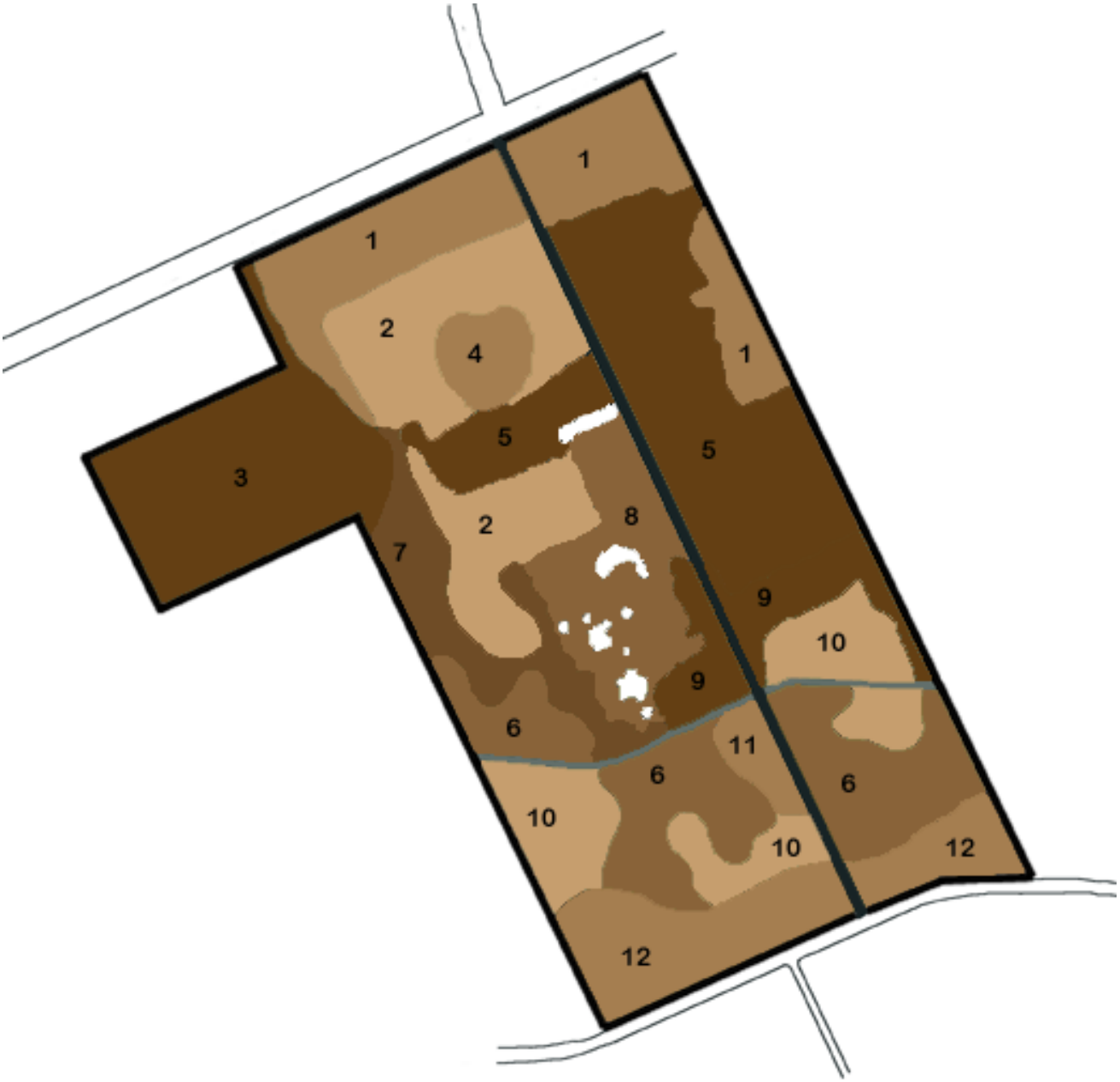

Table 6. Reptiles & Amphibian Species Detections and Locations

Common Name	*Species*	*Numbers Detected/ Location*
Box Turtle	*Terrapene carolina*	roadkills + 2 adults: habitats 3,9
Common Mud Turtle	*Kinosternon subrubrum*	1 in habitat 12
Common Musk Turtle	*Sternotherus odoratus*	in habitat 1
Five-lined Skink	*Eumeces fasciatus*	Building ruins in habitat 8
Broad-headed Skink	*Eumeces laticeps*	in habitat 3
Ground Skink	*Scincella lateralis*	habitats. 3, 6, 7, 9, 12
Eastern Worm Snake	*Carphophis amoenus amoenus*	in habitats 1, 3
Northern Black Racer	*Coluber constrictor constrictor*	1 in habitat 7
Ringneck Snake	*Diadophis punctatus*	in habitats 3, 6
Black Rat Snake	*Elaphe obsoleta obsoleta*	1 roadkill, 1 adult, habitat 7
Rough Green Snake	*Opheodrys aestivus*	in field 5
Eastern Ribbon Snake	*Thamnophis sauritus*	1 along pipeline corridor
Common Garter Snake	*Thamnophis sirtalis*	, pipeline corridor (J.Bell)
Marbled Salamander	*Ambystoma opacum*	adult in habitat 12
Spotted Salamander	*Ambystoma maculatum*	1 in hab. 7, (Arch. survey team)
Four-toed Salamander	*Hemidactylium scutatum*	adult in hab 1; 2 disp.larvae in 4
Three-lined Salamander	*Eurycea longicauda guttolineata*	Many larvae, 50+ in wetland 4
American Toad	*Bufo americanus*	Many crossing 614 at night.
Fowler's Toad	*Bufo woodhousii fowleri*	Several (10-15) disp. juveniles, 9
Gray Treefrog	*Hyla versicolor*	- in habitat 3
Northern Spring Peeper	*Pseudacris crucifer crucifer*	80-100 calling males, at 4
Upland Chorus Frog	*Pseudacris triseriata feriarum*	0-25 calling males , at 4
Green Frog	*Rana clamitans melanota*	3-5 juveniles in habitat 3
Southern Leopard Frog	*Rana utricularia*	-5 calling males, at 4
Pickerel Frog	*Rana palustris*	3-4 calling males, at 4

CONCLUSION

The Green Spring Unit is difficult to assess in terms of significant habitats. Rather than simply a forest with centrally located fields, it is a somewhat complex mosaic of habitats that vary individually enough to comprise slightly different faunal communities. As a result, attention should probably be focused on the more unique habitats relative to what is available in the surrounding landscape. Another alternative would be to prioritize those habitats known to harbor the most unique faunal communities.

Foremost among the more unique habitats is the scrub-shrub wetland (HU#4). Although relatively small, it harbors a unique vegetation community for the area. When inundated, it provided the only significant breeding site for amphibians on the property. When dry, it harbored the only community of a relatively uncommon mammal, the Eastern Harvest Mouse. And during both hydrologic events, this site was central to supporting the only shrub nesting birds. In addition, it provided copious amounts of pollen to an impressive insect community when the buttonbush was in bloom, and pollinating insects are becoming an increasing ecological concern. There is currently no permanent water source on the property, so there is no mechanism by which to maintain a stable aquatic wildlife community. As a result, **this site should receive attention under any change in management or habitat modification.**

On a larger scale, the most significant vegetation community for wildlife on the property is easily the wild field area (HU#5). It does not harbor the overall diversity of species that other areas do, but it is becoming an increasingly rare cover type in the surrounding landscape. Native grassland and shrub habitats support not only a unique breeding community of birds, but receive visitation from numerous other species that live in adjacent habitats. They provide direct prey support to swallows and swifts as well as preferred hunting grounds for most birds of prey. Many snakes utilize these habitats because of the often richer and more diverse small mammal community. **This cover type is rapidly becoming the new "old growth forest" among bird conservationists in particular. Future management actions should strive to perpetuate these areas in a natural, grassland/shrub state whenever possible.**

Among the forested components, the lowland hardwood forest along Route 614 (HU#11) near the intersection with Route 5 stands out. It **supported the largest percentage of declining neotropical migrants, and was richest in overall bird diversity during migration.** At least 4 warbler species were found only in association with this area, as were most of the snakes, turtles, and some of the adult amphibians. An abundant dragonfly and damsefly community was resident here as well, until well into the drought.

Secondary to the lowland forest is the hardwood dominated forest of the western property extension and along the western property boundary (HU#3). Although there is an abundant sapling community present in some areas, the overstory is primarily mature hardwoods, including some significant mast trees. This area accounted for the majority of the larger mammal territories, the majority of the high canopy nesting birds, the highest density of winter bird visitors, and the most diverse community of reptiles and amphibians outside the breeding season. **In every forested landscape in the eastern United States, a mature hardwood forest is the cornerstone of a diverse and stable faunal wildlife community, and this is one is a good example.**

Although not the prettiest habitat, with its vines and briars, treefalls and snags, **the edge hardwood forest labelel #9 actually yielded the highest number of bird species detected over the course of the project.** Essentially because of its scrappy appearance, in conjunction with its extensive amount of edge habitat, this habitat unit harbored fully two thirds of the total diversity of birds recorded over the project period. The underlying meaning to this however is that the birds recorded here were most often birds passing from one habitat unit to another, or birds simply in transit across the landscape looking for a quick perch. In fact, the spring migration was the time period in which this habitat was in highest demand. **The structural complexity of the habitat serves to accommodate a maximum number of species in search of food and shelter, while en route to more optimum habitats.** Otherwise, the habitat is just too narrow for the most part to support true deciduous forest species for nesting. And Brown-headed Cowbirds were frequently observed all along the edge patrolling for host species' nests in which to lay their eggs.

SITE PLANNING CONSIDERATIONS

In view of the current evaluation of the Green Spring Unit for accommodating public visitation and enhancing access, there are a few considerations that should be taken into account from a wildlife diversity perspective. **Foremost among them should be the preservation and protection of any wetland sites**. In particular, the scrub-shrub / forested site in the northern section should stay free from vehicular as well as pedestrian traffic to the extent possible. The amphibians that utilize this site may be traveling from substantial distances to reach the area. There already exists a formidable osbstruction in the form of Route 614. In addition, many dispersing adults and juveniles look to refuge in the immediate moist earth and leaf

litter around the wetland. Any compaction or removal of these microhabitats could engender even graver consequences for an already marginally viable, yet valuable, site.

Regarding the grassland habitats, the wild field areas were mowed at an inopportune time in the spring. The late April mowing did not permit the herbaceous plants to regenerate fully enough to provide ample breeding habitat for many of the species from the previous year. Prairie Warblers, Yellow-breasted Chats, Blue Grosbeaks, Indigo Buntings, and Field Sparrows had all used the shrubby field to breed in 1997. Only the Field Sparrows and an Eastern Meadowlark pair were able to make use of the stunted vegetation in 1998 after the mowing. In addition, the winter shrub cover had been a haven for American Tree Sparrows and White-crowned Sparrows for at least the previous three winters, but another late September mowing, in conjunction with the drought, seems to have decimated the winter cover in the wild fields. Both of these sparrows are irregular winter visitors to southeastern Virginia,and it was unusual for that field to have supported such large numbers of tree sparrows (up to 35) each previous winter. As a result, and in conjunction with the other survey data for this site, **a strong recommendation would be to attempt to maintain this area in a grassland/shrubland state to the extent possible into the future. Just the rarity alone of this type of habitat in the Coastal Plain speaks to the need to address its preservation.** Although somewhat unsightly, the wildlife benefits to a transitional field should be weighed heavily against any rationale for changing the cover type.

Likewise, the lowland hardwood forest along Rt. 614 (HU#11) should be kept free from disturbance if possible, particularly as regards removal of trees. Walking trails could potentially be accommodated in the general area, but only as a last resort. The rich herbaceous community there provides critical habitat for a number of specialized bird species in addition to favored hunting grounds for many reptiles, amphibians and small mammals. On the other hand, the mature hardwood forest along the western boundary and in the western extension could accommodate pedestrian traffic more easily with less negative impact to the faunal community, and better opportunities to observe wildlife.

In view of the fact that the majority of the historical sites are associated with the fescue field areas (HU#8), there would be minimal harm from expanding public access into this area. **Every attempt should be made to protect the overstory mast trees present in mid-field, but beyond that, there would be few negative impacts to faunal diversity. Other associated habitats that could be salvaged for public access include any regenerating pine stands.** These stands are too dense for most species to utilize and allow no sunlight to reach the ground. **Opening up these stands would be ideal for public trails and inroads into the forest proper.**

With regards to increased access into the fescue fields (HU#8), any changes should be limited to the ground habitats. The edges of the forest around these fields are often dominated by a rich assemblage of vines and brushy vegetation. This too should be preserved wherever possible. **Many species are specific to edge habitats, and these edges are excellent examples of the type of transition between open and forested lands that accommodate the most species.** Insertion of a path or road into the forest is fine, but "cleaning" up the forest edge by removing "unsightly" vegetation should be avoided if at all possible.

BIBLIOGARPHY

Dunkle, Sidney W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers. Gainesville, Florida.

Dunkle, Sidney W. 1989. Dragonflies of Florida, Bermuda and the Bahamas. Scientific Publishers. Gainsville, Florida.

Glassberg, Jeffrey. 1993. Butterflies through binoculars. Oxford University Press. New York, New York.

Heyer, W. R., M.A. Donnelly, R.W. McDiarmid, L-A.C. Hayek and M.S. Foster. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution Press.

Ingram, Amanda. 1998.

Linzey, Donald W. and M. J. Clifford. 1981. Snakes of Virginia. University Press of Virginia, Charlottesville.

Opler, Paul A. 1998. A field guide to eastern butterflies. Houghton Mifflin Company, New York, New York.

Scott, J.A. 1986. The butterflies of North America. Stanford University Press. Stanford, California.

Webster, W.D., J.F. Parnell and W.C. Biggs. 1985. Mammals of the Carolinas, Virginia and Maryland. University of North Carolina Press. Chapel Hill.

Woodbury, Elton N. 1994. Butterflies of Delmarva. Tidewater Publishers. Centreville, Maryland.